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this address, and in that of Professor Eddy, the personal experience of the speaker is so introduced as to give a peculiar value to what is said. Professor Langley of Ann Arbor discusses 'Chemical affinity,' "the bud our science put forth in its alchemical stage," but a bud which of late appears to have withered. By an elaborate review he endeavors to show that "it is the word only which has become obsolete; the idea behind it is still active and of great importance." Professor Thurston, now of Cornell, takes a much broader theme, the 'Mission of science,' and naturally falls into a more rhetorical paper. In almost optimistic language he points out the value of applied science, and especially of mechanics as an aid to government in the promotion of social welfare. "The mission of science," he claims, "is to be fulfilled mainly through the application of mechanics." It has made as yet "but the veriest beginning," — but in the end the improvement of mankind and the development of the human soul are within the range of its potentials. The geological address, by Prof. N. H. Winchell, is in marked contrast to that of Professor Thurston. It is a paper of purely professional interest. He discusses, as a geologist, the crystalline rocks of the northwest, and especially of Minnesota. It has been usual to refer these rocks either to the Huronian or the Laurentian: now this nomenclature is acknowledged to be imperfect. The difficulties and incongruities of the situation are clearly set forth. Professor Cope likewise addresses an audience of specialists, — though the biological specialists in these days are a very comprehensive company. His subject is 'Catagenesis;' and he announces his definition of life to be "energy directed by consciousness, or by a mechanism which has originated under the direction of consciousness," — and he concludes that "all forms of energy have originated in the process of running down, or specialization from the primitive energy." Professor Wormley's address on the applications of the microscope in chemical and micrometric observations is only given in abstract. Professor Morse discusses man in the tertiaries, — not any particular man, we may assure our sceptical readers, but the possibly-to-be-discovered man. "The progenitors of quaternary man, under different genera possibly, are to be sought for in the tertiaries." In the section devoted to economics, Gen. John Eaton very briefly considers scientific methods and scientific knowledge in common affairs.

### EXPERIMENTS IN MEMORY.

WHEN we read how one mediaeval saint stood erect in his cell for a week without sleep or food, merely chewing a plantain-leaf out of humility, so as not to be too perfect; how another remained all night up to his neck in a pond that was freezing over; and how others still performed for the glory of God feats no less tasking to their energies, we are inclined to think, that, with the gods of yore, the men, too, have departed, and that the earth is handed over to a race whose will has become as feeble as its faith. But we ought not to yield to these instigations by which the evil one tempts us to disparage our own generation. The gods have somewhat changed their shape, 'tis true, and the men their minds; but both are still alive and vigorous as ever for an eye that can look under superficial disguises. The human energy no longer freezes itself in fishponds, and starves itself in cells; but near the north pole, in central Africa, on alpine 'couloirs,' and especially in what are nowadays called 'psycho-physical laboratories,' it may be found as invincible as ever, and ready for every fresh demand. To most people a north-pole expedition would be an easy task, compared with those ineffably tedious measurements of simple mental processes of which Ernst Heinrich Weber set the fashion some forty years ago, and the necessity of extending which in every possible direction becomes more and more apparent to students of the mind. Think of making forty thousand estimates of which is the heavier of two weights, or seventy thousand answers as to whether your skin is touched at two points or at one, and then tabulating and mathematically discussing your results! Insight is to be gained at no less price than this. The new sort of study of the mind bears the same relation to the older psychology that the microscopic anatomy of the body does to the anatomy of its visible form, and the one will undoubtedly be as fruitful and as indispensable as the other.

Dr. Ebbinghaus makes an original addition to heroic psychological literature in the little work whose title we have given. For more than two years he has apparently spent a considerable time each day in committing to memory sets of meaningless syllables, and trying to trace numerically the laws according to which they were retained or forgotten. Most

*Ueber das gedächtniss. Untersuchungen zur experimentellen psychologie.* Von HERM. EBINGHAUS. Leipzig, Duncker u. Humblot, 1885. 10+169 p. 8°.

of his results, we are sorry to say, add nothing to our gross experience of the matter. Here, as in the case of the saints, heroism seems to be its own reward. But the incidental results are usually the most pregnant in this department; and two of those which Dr. Ebbinghaus has reached seem to us to amply justify his pains. The first is, that, in *forgetting* such things as these lists of syllables, the loss goes on very much more rapidly at first than later on. He measured the loss by the number of seconds required to *relearn* the list after it had been once learned. Roughly speaking, if it took a thousand seconds to learn the list, and five hundred to relearn it, the loss between the two learnings would have been one-half. Measured in this way, full half of the forgetting seems to occur within the first half-hour, whilst only four-fifths is forgotten at the end of a month. The nature of this result might have been anticipated, but hardly its numerical proportions.

The other important result relates to the question whether ideas are recalled only by those that previously came immediately before them, or whether an idea can possibly recall another idea, with which it was never in *immediate* contact, without passing through the intermediate mental links. The question is of theoretic importance with regard to the way in which the process of 'association of ideas' must be conceived; and Dr. Ebbinghaus's attempt is as successful as it is original, in bringing two views, which seem at first sight inaccessible to proof, to a direct practical test, and giving the victory to one of them. His experiments conclusively show that an idea is not only 'associated' directly with the one that follows it, and with the rest *through that*, but that it is *directly* associated with *all* that are near it, though in unequal degrees. He first measured the time needed to impress on the memory certain lists of syllables, and then the time needed to impress lists of the same syllables with gaps between them. Thus, representing the syllables by numbers, if the first list was 1, 2, 3, 4 . . . 13, 14, 15, 16, the second would be 1, 3, 5 . . . 15, 2, 4, 6 . . . 16, and so forth, with many variations.

Now, if 1 and 3 in the first list were learned in that order merely by 1 calling up 2, and by 2 calling up 3, leaving out the 2 ought to leave 1 and 3 with no tie in the mind; and the second list ought to take as much time in the learning as if the first list had never been heard of. If, on the other hand, 1 has a *direct* influence on 3 as well as on 2, that influence should be exerted even when 2 is dropped

out; and a person familiar with the first list ought to learn the second one more rapidly than otherwise he could. This latter case is what actually occurs; and Dr. Ebbinghaus has found that syllables originally separated by as many as seven intermediaries, still reveal, by the increased rapidity with which they are learned in order, the strength of the tie that the original learning established between them, over the heads, so to speak, of all the rest. It may be that this particular series of experiments is the entering wedge of a new method of incalculable reach in such questions. The future alone can show. Meanwhile, when we add to Dr. Ebbinghaus's 'heroism' in the pursuit of true averages, his high critical acumen, his modest tone, and his polished style, it will be seen that we have a new-comer in psychology, from whom the best may be expected. W. J.

#### NOTES AND NEWS.

THE articles of scientific interest in the general English and American magazines for August are neither numerous nor interesting. Two topics seem to have monopolized the popular scientific mind during the midsummer months, — dogs and cholera.

There are two articles on dogs worth mentioning. One is a paper in *Bailey's monthly magazine* on 'The descent of the foxhound,' in which the writer attempts to show that the foxhound was produced about the beginning of the eighteenth century by a process of careful selection, and not, as some have supposed, by crossing a swift-footed hound with some dog of keener scent. In the *Century* appears the second part of Mr. John E. Thayer's beautifully illustrated account of 'Typical dogs.' A clear and concise account is given of the appearance, traits, etc., of the water spaniels, collies, and fox-terriers.

Six gentlemen of the medical profession have taken occasion to express themselves on the cholera question.

In the *Nineteenth century*, Dr. Charles Connor, in an article entitled 'Anti-cholera inoculation,' attempts to show statistically that Dr. Ferran's experiments have been more successful than those of Jenner were; and that by the anti-cholera vaccination process the danger of dying from cholera is made about six times less than it would be under normal circumstances. Dr. J. Burdon Sanderson, in the *Contemporary review*, gives his views on the causes and prevention of cholera. This writer gives a brief sketch of the history of cholera, shows to his own satisfaction that Koch's comma bacillus has nothing to do with cholera, and then goes on to say the ordinary things about good drainage, careful diet, etc. But it is in the *North-American review* that the greatest number of articles, and the least amount of information, is to be obtained on the subject of Asiatic